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Mathematics News Letter

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To mathematics in general, to the following causes in particular is this journal dedicated: (1) the common problems of high school and college mathematics teaching, (2) the disciplines of mathematics, (3) the promotion of M. A. of A. and N. C. of T. of M. projects.

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EXPANSION, ONCE MORE

While this journal is devoted primarily to the cause of mathematics and its teaching in the Louisiana-Mississippi area there is no equity or ethics to prohibit us from bidding for support in other states of the Union. Being essentially a magazine of service, if the Mathematics News Letter has a message of value for the teacher of Mississippi, may not the same message be offered to other teachers in other places?

The plea can be made on far stronger and more compelling grounds. The cost of maintenance of the News Letter is not being met,—not even nearly met—by the paid-in subscriptions of Louisiana and Mississippi. The causes of this delinquency are not here being discussed. It is pertinent, however, to suggest that if the policy of deriving our maintenance costs mainly from our subscribers is to be continued, its success, for the present at least, can be made possible only by appealing for subscription support to the friends of mathematics in other territory than our own.

Despite the present seeming necessity for such an appeal in order to avert disaster, we never-the-less have confidence to believe that when the executive committees of the Louisiana-

Mississippi Section of M. A. of A. and the Louisiana-Mississippi Branch of the N. C. of T. of M., acting jointly, proceed seriously to carry out the resolution approved by the last joint Section-Council meeting, namely, to organize a campaign for a maximum of paid-up subscriptions in every county of Mississippi and every parish of Louisiana, a new and a far more gratifying situation for the Letter in Louisiana-Mississippi will have its beginning.

—*S. T. S.*

AGGRESSIVE MATHEMATICS

The rich disciplines of properly directed mathematical study are real enough to the mathematician. But the genuine lover and student of mathematics is prone to preoccupation with the object of his affection. Too seldom is he fired with a missionary zeal to tell the story of these disciplines to those who know them not. Much less disposed is he to challenge the attitudes of the numberless modern youths whose hurried social programs are inconsistent with the rigid exactions of mathematical study. Thus is there need of a certain militancy of attitude on the part of the professional mathematical worker to all influences which are operating to discount mathematics. How many pages would be required to list the names of the individuals of a single State who, after avoiding mathematics because of its alleged difficulty. later found a need for it in their work? Long would be the list of those who, after having chosen and successfully done a reasonable amount of college mathematics, later have been heard to say, "I am glad I chose some mathematics because, more than anything else did it give me training in logic." The publication of such lists, and others of similar import, in the Mathematics News Letter or other mathematical journal, if accompanied by a few circumstantial facts in each case, would **be just one of many ways of making mathematics aggressive.**

—*S. T. S.*

STIMULATING INTEREST

Various means of stimulating the interest of high school mathematics students have been suggested. Many of these have been the result of investigations. One method that should

prove successful to some extent is that of giving little biographical sketches of great mathematicians when dicussing theorems or principles for which they are responsible, or to which they have contributed. This is done in the high school in the mastery of other subject matter. Why not use it more extensively in mathematics? Why is it more essential to give the date of birth and death and the nationality of Galileo in studying atmospheric pressure than to tell something of Pythagoras in studying the Pythagorean Theorem; or, to say something of Descartes in introducing the radical sign. In solving quadratic equations the boys in an advanced algebra class became keenly interested when they were informed that the equation which they were to solve was taken from Steinmetz's solution of the problem of the current strength in a divided electric circuit. They were interested because they knew something of Steinmetz.

—*H. S.*

OPPORTUNITY FOR HIGH SCHOOL TEACHERS

Much interest was displayed by the teachers present at the meeting of the Mathematics section of the L. T. A. in the discussion of the prerequisites to the successful pursuit of college mathematical study. Many of the teachers on this occasion had something to say on the subject. I am sure that there are many more who would like to contribute something. There are some who would like to state what progress the high schools have made along this line. There are those who would like to outline the difficulties that face the high school mathematics teacher in measuring up to all demands. Then there are probably those who can give experiments that have proved successful in meeting some of them. In view of the fact that a large number of high school graduates go to college, the subject of preparation for college seems a vital one. We offer the high school teachers an opportunity to enter into such discussion and urge them to use the columns of the News Letter to make whatever contribution they wish on this subject.

—*H. S.*

Under present postal rules a 24-page magazine is mailable in a 1-cent wrapper.

LABORATORY METHOD OF TEACHING MATHEMATICS IN THE CLASSROOM

By CECELIA E. GRIMM
Benjamin Franklin School, New Orleans, Louisiana

When the term laboratory is mentioned in connection with any subject a mental picture is immediately formed of a classroom equipt with long and heavy tables and numerous cases whose shelves are plentifully stocked with apparatus and equipment. Although a laboratory is defined as a work shop devoted to experiments in any science for the purpose of observing the laws in operation, formulating its principles, and systematizing them, the question might well be raised whether it is essential that the student follow directions in performing an experiment or a series of experiments, and whether or not it is possible to do laboratory work in schools where classes cannot be equipped like laboratories. If it is, the great advantages derived from the method should be made available to all schools and pupils.

Leading educators, realizing the need of such adaptation after a careful study of the purpose of the laboratory method have formulated the following—"Laboratory methods provide the subject matter of instruction in the form of real, present experiences." This practice contrasts with the methods in which the subject matter was derived through the medium of books or teachers or from the past real experiences of students.

Securing information through observation is predominant in study in general. The subject matter of laboratory instruction should be adapted to the social needs of the various classes of students, and thus necessitate relating the experimentation very definitely to processes that play a large part in practical affairs of ordinary people. There is a danger in using a superabundance of material in experimentation instead of relating experimentation to a few large topics or problems. The laboratory method might also be abused by being used indiscriminately, for example, where reflective thinking and observation are more important than acquiring skill in manipulation. Thus highly specialized forms of motor skill should be avoided.

One's mental attitude does not change just because he engages in certain physical manipulations and handles certain tools

and materials. A student may acquire laboratory methods as so much isolated material just as he may so acquire subject matter from a textbook. The problem of turning laboratory technique into intellectual account is infinitely more important than the utilization of information obtained from textbooks.

For centuries, chief reliance was placed upon curiosity and imitation. From the time of Froebel more use has been made of play, and, lately, constructiveness and the social instincts have begun to be utilized. In so many school rooms practically the only educational activity that goes on is that of listening, an absorbing state of passivity on the part of the pupil with the teacher as the main cog in the machine. It means the dependence of one mind upon another.

The laboratory plan does away with this situation entirely. There has been a realizing of the fact that pupils are exceedingly interested in muscular activity and, since this involves work with concrete materials, it was recognized that they could think better in terms of concrete cases which they could understand, rather than memorize abstract facts that are foreign to them.

The common tendency has long been to emphasize the course of study or the prescribed requirements at the expense of the pupil's development and his real interests. The textbooks and any other information should be a means to an end and not an end in themselves, for much of the information acquired is sooner or later lost.

The value of the laboratory method may be summarized as follows:

1—Failures are decreased.

2—The pupil's power to retain what he has learned has been greatly increased.

3—It produces independent workers and thinkers.

4—It is an effective method of bringing home to the pupil the importance and appreciation of the subject matter.

5—It supplies a motive for the study of mathematics and arouses interest in the pupil for the subject.

6—It develops good study habits.

7—It adds to the ability of the pupil to master the subject material with the least possible expenditure of time and effort.

8—It will do much toward the elimination of the most seri-

ous criticisms and will make the position of mathematics in the curriculum more secure.

I will endeavor to explain to you one large subject which is taught by means of the Laboratory Method in our school. That subject is banking. We have built in the room a large booth, or* cage, similar to those of the large banks. This booth contains two openings or windows, one for the paying teller and the other for the receiver. The children are given certain days when they are to hold these different positions and they are held responsible for the work on those days. Play money is given to them to pay any checks or withdrawals brought in.

Each member of the class is given a start with $500. They immediately write out a promissory note payable to me, agreeing to pay me back my money in two weeks. They then deposit this money in the bank, each writing out an identification card and a deposit slip. The children who are working in the bank file these slips and give a small pass book to each child. I failed to tell you the name of our bank. It is the Junior Citizens' Bank. So of course the children are proud to see that name on their pass book.

Besides the receiver and paying tellers some children are appointed to be bookkeepers and others cashiers.

The children are told that for every correct paper or board work they will be given an additional $100. That is how they earn their money to pay back their note. If they got $100 I write out a check for them and they deposit it in the bank. If they fail they have to give me a check. Each day their books are left with the bookkeeper to be balanced.

At the end of two weeks or maybe for a longer time, the children withdraw their $500.It is interesting to note how proud they are to pay me back my money.

When we had the school savings bank, the children who are most proficient in this work were appointed to be workers in the school bank. These children had entire charge of the savings of all the pupils of the school. They had then the responsibility of handling real money, writing out deposit slips, filing returns in pass books, and sending to the bank a balanced sheet. Very little assistance did they receive from me, for of course they wanted to be called experienced bankers.

*(The school savings banks are no longer used in the N. O. schools.)

MATHEMATICS TEACHING PROBLEMS

By DORA M. FORNO
New Orleans Normal School

The enormous increase in the use of mathematics in the ever widening fields of industrial and scientific work is making greater demands on the schools for more and better preparation on the part of students to meet these demands. Mechanical aids, such as the slide rule and the comptometer, have done much to facilitate calculation and free the mathematician from the dull practice of having to check his work three or four times to be sure he was right. But these aids do not supply all the demands of mathematics.

The demands for more and better preparation on the part of students of mathematics means greater responsibility on the part of teachers in all departments of mathematics. It is not solely the problem of the college to equip its students more efficiently to meet the problems of the industrial and scientific world; it is a problem for the high schools and grade schools as well. If the high schools and colleges are to develop every healthy-minded student so that he can attain some degree of success in mathematical study,—an objective proposed by one of our editors—, the elementary schools must share this responsibility. My observation and study of this problem has shown me that many of the teachers of the elementary schools are cognizant of some of the problems of business, industry and science and are exerting their best efforts to lay a foundation of fundamental facts and processes of arithmetic and to develop the maximum reasoning power of which each pupil is capable.

Much valuable data have been gotten by scientific studies as to what phases of arithmetic are demanded by the business and industrial world, the best methods by which the student can be put in possession of the fundamental facts and processes, what are the most difficult facts in any given series, and how to get the desired results with least expenditure of time and energy. We have many excellent school arithmetics, much supplementary material to aid in bringing about better results and many excellent books on "Methods of Teaching Arithmetic,"—more and better ones than in any other branch of mathematics—, but the

hope for better results lies in the teachers who are filled with the fire of enthusiam and high ideals.

The teacher who is getting results proportionate to the amount of energy put into the work is the sympathetic teacher who knows how to interest his pupils so that he gets their co-operation to want to learn what they should learn. He must know how to regulate the atmosphere of the classroom so as to permit pupils to express themselves freely and without restraint and to develop a spirit of hearty cooperation, and he must know the various temperaments and various talents of his pupils that each may be directed to develop the maximum abilities of which he is capable. The task of the teacher is no easy one; truly, it is a great responsibility, but filled with wonderful opportunities.

Educational critics are prone to boast of achievements or to complain of lack of achievements without giving thought to the laborious efforts by which these achievements were accomplished or to the causes of lack of achievement. It is important that diagnoses must be made. Diagnoses? Yes. But, then, what next? We must know how good results have been attained as well as the causes of poor results. The Mathematics News Letter has an important function as an avenue for disseminating knowledge of how to get good results. Some of our best teachers are hiding their talents under a bushel, when they should be sharing them with their co-workers.

Lack of achievement in any field of mathematics may be due to many causes and a careful diagnosis of such causes is necessary before one can say that the cause is due to lack of mental ability, for very frequently the cause has been found to be due to training. Before remedial work can be done, it is of utmost importance that a diagnosis of weaknesses and special difficulties be made. It has been found that corrective measures undertaken to remedy defects increase the efficiency of the teachers, decrease his labors, and at the same time more fully equip his pupils with the tools of mathematics.

Every teacher is confronted with the misfit, the pupil who is not able to do the work of the required type and who is retained and soon becomes a real problem, because a place in the system has not been provided for him.

A device which is exceedingly efficacious in remedial work

is to find first what the class difficulties and individual difficulties are in any phase of work by means of a preliminary test which should include all facts of the series or difficulties of a process to be tested. Get the pupils to note their own difficulties and make them feel a real need for overcoming these difficulties. Then, by systematic drill, get the pupils to master their own difficulties. Measuring progress, both individual and class progress, by means of graphs spurs pupils to do their best work. Group competition brings remarkable results at all times and, if progress is shown graphically, it serves as a wonderful incentive to the slow pupil to try to measure up to the best in his class. No better aim than "to compete against your own past record" can be set up and I find it brings excellent results, especially when it is measured by an individual graph made by the pupil himself. These daily graphs take only a moment of time but save hours of useless talk. When the pupil sets a task for himself and aims to accomplish it, he will.

HOW DO YOU SUBTRACT?

By ADRIENNE RAYL
Beauregard School, New Orleans, Louisiana

This question put to any one individual would most probably appear to him an extremely simple one and one to be answered within a moment or two. But, would we find the same simplicity and brevity in a summary of an aggregate number of replies to our question, "How do you subtract?" Would the processes involved in receiving the same result to the same subtraction example be identical or very nearly so among a large group of individuals?

Charles S. Gibson, in his article "Some Methods in Subtraction", gives an analysis of 30 methods of subtracting 27 from 41. Of course, within these 30 methods, there are only a few outstanding distinctive ones. The others are variations, combinations, and overlappings of these.

Let us consider the few distinctive methods of subtraction:

1. *The First Italian Method or the Decomposition Method.*

The principle involved is that taking one from any order of a number and adding ten to the next order to the right does

not change the value of the number. It can best be presented by an example:

635	8 from 15=7
368	6 from 12=6
267	3 from 5=2

2. *The Second Italian Method or the Method of Equal Additions.*

This method depends upon the axiom that if equal numbers be added to both minuend and subtrahend the remainder will not be changed.

635	8 from 15=7
368	7 from 13=6
267	4 from 6=2

3. *The Austrian or Continental Method.*

Subtraction is considered to be simply addition reversed and the study of the subtraction tables is eliminated.

368	7 and 6=13	Write 6, carry 1.
635	8 and 7=15	Write 7, carry 1.
267	4 and 2= 6	Write 2.

4. *The Method of Decimal Complements.*

This is quite an old method. The decimal complement is employed when the minuend integer is smaller than the subtrahend one.

635	Decimal Complement of 8 is 2. 2 and 5=7
368	Decimal Complement of 7 is 3. 3 and 3=6
267	4 from 6=2

In another variation of this method, the smaller integer is always taken from the larger. If the smaller is in the minuend, the complement is set in the answer.

635	5 from 8=3	Complement 7
368	3 from 7=4	Complement 6
267	4 from 6=2	

The methods involving decimal complements are somewhat unfamiliar and are not commonly used. Within the schools of

our country, it is one of the three first methods that we shall usually find in use.

Let us consider the relative merits of these three methods. A number of experiments have been conducted at different times to ascertain speed and accuracy results of these methods:

P. B. Ballard gave tests in 23 schools using equal additions method and 48 using decomposition method. He found the equal additions method superior in every age group by from 40% to 10%. These findings of the superiority of the equal additions method over the decomposition method were later confirmed by P. L. Gray, W. J. McClelland, and W. H. Winch.

J. T. Johnson tested 277 students in Chicago Normal College using the Courtis Standard Practice Tests. Of the 277 students tested, 220 used the decomposition, 23 equal additions, 13 Austrian, 8 a modified form of the Austrian and 13 a mixed method. The average time required by students using the decomposition method was ¼ greater than that of those using equal additions and ½ greater than that of those using the Austrian.

	Medians in Time	Av. % accuracy
Decomposition	2 min. 20 sec.	90
Equal Additions	2 " 20 "	95.4
Austrian	2 " 00 "	96.3

In order of merit according to this test, the Austrian leads, then comes the equal addition, and then the decomposition method.

Tests were given by Wm. Roantree in 5 New York City Schools to 346 Second B children. 177 had been taught the decomposition method and 169 the Austrian. The accuracy of the latter was found superior to the former.

Three later tests, also in 2B, in the Model School of the New York Training School for Teachers and in another nearby school showed the following medians:

Austrian	20 attempted	17 right	85% accuracy
Decomposition	12 attempted	9 right	75% accuracy

Tests were also given in 3A,3B, and 4B. There were no significiant differences because the processes had already been thoroughly mastered.

Some evidence contrary to the above findings is given by W. W. Beatty, C. C. Meads, and Isabel Seara, who found the decomposition method a little better than the Austrian.

The weight of the evidence of these tests indicates that the popular decomposition method is distinctly inferior to the other two methods and that the Austrian is superior to both the decomposition and equal additions methods.

It is the Austrian method that is being advocated today. In conclusion, let us therefore note some of its outstanding features:

1. It harmonizes with the common practice of making change.

2. It simplifies the process of finding one of several addends, so useful in accounting and in other business forms.

3. The complications that arise in subtracting with o's in the minuend are avoided entirely when the minuend is regarded as a sum to be obtained.

4. The final and perhaps most important feature is that thought moves in the same direction as in addition, resulting in economy of time and effort.

BRIDGING THE CHASM BETWEEN HIGH SCHOOL AND COLLEGE

By W. C. ROATEN

As the number of high school graduates increases from year to year, so increases the number of failures during the first year in college. This is inevitable, since in our earlier days only the intellectually strongest graduated from the high school, and consequently entered college; but now, as the mediocre as well as the stronger are meeting the high school requirements for graduation and are demanding their share of college training, there is a consequent lowering of the average ability of college entrants. Since the college entrance requirements wre made to fit the former high school graduates, and the work of the freshman year was of such a nature that the first year student could with proper application meet its requirements, it follows that the pupil of lower mental ability can not meet the requirements of his first year in college.

That these youngsters are as much entitled to college training as their more fortunate mates goes without saying. The question, then, is, what should be done about it? Obviously,

there should be no lowering of standards. Granted that the high schools are doing all they can to meet the situation, (which in many instances is granting too much) the logical course seems to be for the colleges to see to it that applicants for entrance should not be permitted to enroll in those courses requiring the highest mental ability unless so recommended by the high school authorities.

The tendency of college courses at this time seems to be in the direction of a multiplication of the number of courses to meet the varying demands of applicants; and for the purpose of finding a solution of the problem in hand, there should be an increase in the number of courses giving training in the vocational subjects, thus giving recognition to the legitimate demands of an increasing number of young people who do not wish to take the heavier courses, or are not able to meet their requirements.

In addition to this action, if the colleges would insist on information showing more in detail the ability and personality of the applicants, much would be done to relieve the situation. If the college registrars would put into the blanks which they send to applicants a few more questions calling for more definite information the high school principal would feel free to give details that would greatly help in classifying the applicants.

It is believed that a discussion of this subject is entitled to space in The News Letter, because it is in the field of mathematics that many failures occur.

A NOTE FROM THE BASTROP HIGH SCHOOL

By LILLIE GREENE
Bastrop, La.

The enrollment in the mathematics department of the Bastrop High School shows a decided increase over the enrollment of last year.

An attempt has been made to group pupils according to their ability.

This year there are three sections of plane geometry, four sections of business arithmetic, two sections of ninth grade algebra, but only one section of senior algebra.

The pupils in the A section of plane geometry are doing exceptionally good work, some of them being much above the average in their ability to solve problems.

Throughout all sections of mathematics are to be found pupils with I. Q.'s above the normal.

We expect to accomplish great things during the year, and thus keep Bastrop where she rightfully belongs—at the front.

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*THE MINIMUM TRAINING PREREQUISITE TO THE SUCCESSFUL PURSUIT OF COLLEGE MATHEMATICAL STUDY

By A. C. MADDOX
Head Math. Dept., Louisiana Normal College

(Part One)

The topic of this discussion should be very interesting to the members of this group, for at least three reasons.

There are so many high school graduates who continue their school careers through one or more years of residence in college. There seems to be general agreement among college teachers that many of their freshman students are poorly prepared to pursue the freshman courses.

There seems to be a rather wide-spread interest on the part of the public as to what the facts in this general phase of the educational problem really are.

It is natural to ask if we should really expect the average high school graduate to be able to succeed in college mathematical study, particularly in view of certain claims that are frequently made.

It is claimed by some that college instructors are unreasonable as to the amount of subject matter of mathematics they expect their students to have mastered before entering college.

Some say that college instructors make their courses in mathematics include more subject matter than can be mastered by students whose work in high school indicates that they are students of average ability.

It is contended by some that many college instructors employ very poor methods in their teaching of mathematics, and some think that the nature of mathematics is such as to render

the real mastery of college mathematics impossible in the case of a large percentage of college students.

In my own thinking I have tried to give due consideration to all of these claims. It seems to me to be true that we should expect the high school graduates who enter our colleges to admit of classification into four general groups as to their ability to succeed in college mathematical study: some who simply cannot succeed in the study of real college mathematics; some who can succeed reasonably well with the more elementary courses in college mathematics but cannot succeed with the more advanced courses; others who can succeed fairly well with all undergraduate study of mathematics but are unable to make worth-while advancement in the study of graduate mathematics; some, though perhaps relatively few, who have enough ability and thorough preparation to pursue profitably the study of at least some of the graduate courses in mathematics.

I venture to express the belief that, although there is considerable merit in some of the claims stated above, there are far more students in the first of the four groups of students referred to than there would be if all the high schools would do really efficient work in mathematics and that many are in the second group who would be at least in the third group if they had received the best high school training possible under the present system of public education in the state.

It would be quite natural to ask what we shall mean in this discussion by college mathematical study.

Let us mean that the subject matter of the beginning college courses in the mathematical subjects is based upon what experience has shown the high school student of average ability, working under moderately favorable conditions, to be able to accomplish in the time alloted to the respective subjects in the public high schools of the state.

Let us mean that the procedures and methods of study are such as experience has shown to be on a reasonable level and the most advantageous level for college students of mathematics.

By the successful pursuit of college mathematical study, let us mean that the first time a student takes any college course in mathematics he receives, without condition, the full credit hour value of the course.

Let us mean that the college student of mathematics develops considerable power and inclination to investigate mathematical situations, to discover relations, to make generalizations, to apply mathematical facts and principles, and to check the results of all solutions.

Let us mean that he establishes habits of reasonable accuracy of thought, of language, and of computation; and reasonable ability and inclination to abbreviate oral and written solutions of exercises and problems; and reasonable speed in computation.

Let us mean that the student does not habitually need to delay the progress of the class by asking questions whose answers are simple enough to have been mastered in the high school courses.

Let us mean that the student develops some real appreciation of the subject of mathematics and of the value of mathematical study conducted properly.

A student's pursuit of college mathematical study is not really successful if he habitually fails to read and interpret correctly the mathematical language found in exercise and problem statements and solutions.

He is not really successful in his college mathematical study if he is unable to conduct an investigation independent of the text-book, such as that of determining the value of sin $2x$ in terms of sin x and cos x after he knows the formula for sin $(x+y)$ or that of developing the formula for tan $(x-y)$ in terms of tan x and tan y after knowing the formula for tan $(x+y)$.

He is hardly successful as a college student of mathematics if he habitually needs to delay discussion by asking such questions as, "How did he get $d=\frac{bc^2}{ae}$ from $a=\frac{bc^2}{de}$?" or if he cannot see readily that $3-6x=x-18$ yields the solution $x=3$ or that $(x-y)^2+(y+4)^2=(x-5)^2+(y+2)^2$ yields $8x+4y=12$.

He is not really successful in his study of college mathematics if he habitually says such things as, "I don't see how you get

$$\frac{\dfrac{1}{\cot x}+\dfrac{1}{\cot y}}{1-\dfrac{1}{\cot x \cot y}}=\frac{\cot y+\cot x}{\cot x \cot y-1}.$$

He could hardly be said to be a successful student of college mathematics if one of his habits is to quote a theorem in the belief that such quotation constitutes a valid proof of the theorem.

A student is not studying college mathematics successfully if he habitually commits errors in simple computation, particularly if he usually fails to detect the errors.

He cannot reasonably be regarded as successful in his college mathematical study if he rarely remembers, or if he never deigns, to check the results of his exercise and problem solutions except by reference to answer books.

He is certainly not really successful in college mathematical endeavors as long as he is tenaciously antagonistic toward the subject of mathematics.

He is really not succeeding in the college mathematical field if he never experiences any thrills from mathematical adventures.

Now, it is perfectly natural for the high school teachers of mathematics present to wonder if I am not expecting them to accomplish more than it is reasonable to expect. Let me hasten to express again the opinion that there are some students who cannot really succeed in college mathematical study and that there are others who can successfully pursue only the more elementary courses in college mathematics. It is incumbent, however, upon high school teachers and college teachers to articulate their courses and their teaching methods in such manner as will render it possible for every student to pursue his study of mathematics as far as his natural ability makes such pursuit educationally profitable.

And while this task is a tremendously big task, it should be challenging and exceedingly interesting. So let us consider what training the student must have acquired prior to his entrance into college if he is to be able to pursue college mathematical

study with the type and degree of success that is commensurate with his native mathematical ability.

I am venturing the assertion that the quality of the training is much more important than the quantity. That is to say a few good habits of study thoroughly established, the permanent mastery of the really fundamental concepts, facts, and principles of elementary mathematics, and the desire to grow some mathematics for one's self are the most important elements that can be included in the mathematical training of a high school graduate. To a student in possession of these things, other mathematical facts and relations have far greater significance than they have to a student who is deficient in these fundamental respects.

Let us briefly consider some of the more important study habits that are essential in the mathematical training of a high school student.

The habit of mastering all the terms that are of mathematical significance employed in mathematical work is of fundamental importance. I have tested hundreds of students as to their notion of the meaning of parallelogram and in a great majority of the cases I have found their notion to be erroneous. The same has been found to be true as to their notion of the meaning of isosceles triangle. This lack of understanding of terms is the cause of the student's inability to distinguish between what is true by definition or hypothesis and what is true by proof and of his inability to know when he has completed the proof of a proposition.

No student can acquire adequate training in high school mathematics who does not establish thoroughly the habits involved in the technic of problem solving. This requires specialized drills in problem solving with the view to making the student familiar with the general steps required in the solution of all mathematical problems and to establishing firmly the habit of taking all these steps in his own problem solving. Much of the inability to solve problems is due to the fact that students have not established the habit of determining all the conditions of a problem before undertaking to determine what operations are required in the solution. In this connection it is likewise important to establish the habit of determining whether or not any of the given conditions of the problem are extraneous and

whether or not any of them are dependent upon other given conditions. A certain textbook has in it a problem that refers to a right triangle whose sides are 9, 12, and 15 units in length, respectively. A well trained student notes in this case that four conditions of the triangle are stated when only three independent conditions can be imposed on a triangle; i. e., he notes that any one of the four given condition of the triangle is implied in the other three.

(To be concluded in the January News Letter)

A NOTE ON A DISTANCE FORMULA OF PLANE ANALYTICS

By H. L. SMITH
Louisiana State University

In most books on analytics, the formula for the distance from a point P_0 whose coordinates are (x_0y_0) to the line whose equation is $ax+by+c=0$ is written

$$(1) \qquad d=\frac{ax_0+by_0+c}{\pm\sqrt{a^2+b^2}},$$

subject to the convention that the sign in front of the radical shall be taken as $+$ or as $-$ according as c is a negative or a positive number. This convention means nothing in case $c=0$ and there are usually additional ones to cover that case.

It would seem to be undesirable to introduce arbitrary and unnecessary conventions into mathematics. In this case the need for a convention as to sign may be avoided by writing the formula

$$(2) \qquad d=\frac{|ax_0+by_0+c|}{\sqrt{a^2+b^2}}.$$

Here $|ax_0+by_0+c|$ denotes the absolute value of ax_0+by_0+c, that is, $|ax_0+by_0+c|=ax_0+by_0+c$ if ax_0+by_0+c is a positive number, otherwise $|ax_0+by_0+c|=-(ax_0+by_0+c)$.

It is the object of this note to show that the formula (2) is not only easier to remember but can be applied with greater ease and elegance, particularly in the case of problems in which some of the given elements are literal quantities. This is done by consideration of two examples.

Example 2. Find the locus of points equidistant from the two lines $3x-y+6=0$, $x+2y+3=0$.

Solution. The point P (xy) is equidistant from the given lines if, and only if,

$$\frac{|3x-y-6|}{\sqrt{10}}=\frac{|x+2y+3|}{\sqrt{5}};$$

and hence if, and only if,

$$\frac{3x-y-6}{\sqrt{10}}=+\frac{x+2y+3}{\sqrt{5}}.$$

Example 2. Find a circle through the points (2, 0), (5, 9) tangent to the line $4x-3y-18=0$.

Solution. Let the centre of the required circle be (h, k) and its radius be r. Then

(3) $$(h-2)^2+k^2=r^2,$$

(4) $$(h-5)^2+(k-9)^2=r^2,$$

(5) $$\frac{|4h-3k-18|}{5}=r.$$

The first step in the solution of these equations is the removal of the absolute value signs in equation (5). This step is taken by aid of the following

Principle. If the coordinates of two different points are substituted for x and y in the expression $ax+by+c$, the results will be like in sign or unlike in sign acording as the two points are on the same side or on opposite sides of the line $ax+by+c=0$.

In applying this principle to our problem, it is to be noted that when (2, 0) are substituted into $4x-3y-18$, the result is the negative number -10; hence, since the points (2, 0), $(h\ k)$ are on the same side of $4x-3y-18=0$, the result of substituting $(h\ k)$ into $4x-3y-18$ is negative, so that $|4h-3k-18|=-(4h-3k-18)$. Hence (5) is equivalent to

(6) $$4h-3k-18=-5r.$$

The remainder of the solution is as follows: Subtraction of (3) and (4) gives

(7) $$h+3k=17.$$

Solution of (7), (6) for h, k in terms of r gives

(8) $$h=7-r,\quad k=(10+r)/3$$

Substitution of (8) and (3) gives

$$r^2-70r+325=0,$$

from which $r=5$ or 65. Then finally by (8), when $r=5$ it follows that $h=2$, $k=5$ and when $r=65$ it follows that $h=-58$, $k=25$.

The reader will note that the absolute value signs in (5) were removed by making use of the geometric fact that the centre and any point on the circumference of a circle are on the same side of our tangent to the circle; this fact would still have been available for use for the same purpose if, in the problem, the coordinates of the given points and the coefficients of the equation of the given line had been literal numbers.

PROBLEMS

Proposed by H. L. Smith: Show that the inequality

$$|(x_1-x_2)(y_1+y_2)+(x_2-x_3)(y_2+y_3)+(x_3-x_1)(y_3+y_1)|$$
$$\leqq|x_1-x_2||y_1-y_2|+|x_2-x_3||y_2-y_3|+|x_3-x_1||y_3-y_1|$$

hold for all real values of the six letters involved and and give a geometric interpretation.

Solved by S. T. Sanders: Denote by L and R the left and right members, respectively, of the inequality to be established. Thus,

$$L=|(x_1-x_2)(y_1+y_2)|+(x_2-x_3)(y_2+y_3)+(x_3-x_1)(y_3+y_1)|$$
$$=|x_1(y_2-y_3)+x_2(y_3-y_1)+x_3(y_1-y_2)|$$
$$R=|x_1-x_2||y_1-y_2|+|x_2-x_3||y_2-y_3|+|x_3-x_1||y_3-y_1|$$

The generality of neither L nor R will be affected if when $x_1-x_2\leqq 0$, we write $(x_1-x_2)(y_1+y_2)=|x_1-x_2|(-y_1-y_2)$, and a corresponding transformation for x_2-x_3, if $x_2-x_3\leqq 0$.

Hence, if $x_1-x_2=a$, and $x_2-x_3=b$, we shall have

$$x_3-x_1=-(a+b),\quad a,\ b\geqq 0$$

(1) If $y_1-y_2=c$, $y_2-y_3=d$, $y_3-y_1=-(c+d)$, $c,\ d\geqq 0$,

$$L=|ad-bc|\leqq|ad|+|bc|$$
$$R=|ac|+|bd|+|ad+bc+ac+bd|$$
$$=|ac|+|bd|+|ad|+|bc|+|ac|+|bd|,\text{ since } a,\ b,\ c,\ d\geqq 0$$

Whence, $L\leqq R$

(2) If $y_1-y_2=-c$, $y_2-y_3=-d$, $y_3-y_1=(c+d)$, $c,\ d\geqq 0$,

$$L\leqq|ad|+|bc|$$
$$R=|ac|+|bd|+|ad|+|bc|+|ac|+|bd|$$

Whence, $L\leqq R$

(3) If $y_1-y_2=c$, $y_2-y_3=-d$, $y_3-y_1=d-c$, $c, d \geqq 0$

$L=|ad+bc|$

If $c \geqq d$, $R=|ac|+|bd|+|ac+bc-ad-bd|$

$=|ac+bd|+|ac+bc|-|ad+bd|$, since, $a, b, c, d \geqq 0$

Since $c \geqq d$,

$|ad+bc| \leqq |ac+bc|$

Also, $|ac+bd|-|ad+bd| \geqq 0$

Whence, $L \leqq R$

When $d \geqq c$, we may write

$R=|ac+bd|+|ad+bd-ac-bc|$

$=|ac+bd|+|ad+bd|-|ac+bc|$, since $a, b, c, d \geqq 0$

Since $d \geqq c$

$|ad+bc| \leqq |ad+bd|$

Also, $|ac+bd|-|ac+bc| \geqq 0$

Whence, $L \leqq R$

(4) If $y_1-y_2=+c$, $y_2-y_3=-d$, $y_3-y_1=d-c$, $c, d \geqq 0$.

$L=|ad-bc|$

$\leqq |ad+bc|$,

Since, by (3) $|ad+bc| \leqq R$, it follows that

$L \leqq R$,

If two or more of $a, b, c, d=0$, or if $ad-bc=0$,

$L=R$

Geometric Interpretation

Let (x_1,y_1), (x_2,y_2), (x_3,y_3) be the coordinates of any three points of a plane, when referred to rectangular axes.

Then L=twice the area of the triangle determined by the three points,

or, $L=2A_1$

Also R=twice the sum of the areas of three right triangles having for their respective hypotenuses the sides of triangle A_1

or, $R=2A_2+2A_3+2A_4$

Thus, the theorem states that

$A_1 < A_2+A_3+A_4$

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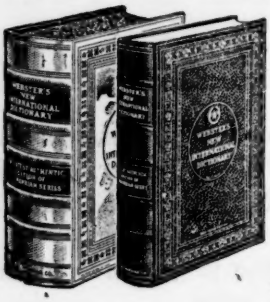

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